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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003903018 for a patent by SCALZO AUTOMOTIVE RESEARCH PTY LTD as filed on 16 June 2003.

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VARIABLE STROKE PISTON ENGINE.

This invention relates to variable displacement or stroke, internal combustion engines and more particularly to an arrangement having efficient power-transmitting for stroke varying mechanism whereby the displacement of the pistons is varied by the piston stroke. These types of stroke varying mechanisms are known to contribute substantial fuel economy improvements during part load operation.

Conventional internal combustion engines (ICE) are generally configured in an in-line, horizontally opposed or in a V formation. In a vehicle installation they are sized in volumetric capacity to achieve the desired maximum speed and acceleration requirements. This engine size generally means that at low load conditions, deceleration and braking periods, which is majority of the time, the fuel consumption is high because the engine needs to be throttled and operate at a much lower overall efficiency..

Many attempts have been made to reduce the capacity of the engine during low load conditions by variable stroke mechanisms, and cutting off fuel to some of the cylinders, however, most have not been successful.

It is the object of this invention to present an improved mechanisms for varying the stroke of each piston in a multi-cylinder engine. The stroke of engine pistons can be adjusted at a very fast rate as demanded by the vehicle via sensors and an engine management system. In addition, the geometry of the link mechanism can be adjusted to allow for either, a nearly constant compression ratio or a variable compression ratio between its two extremes. Furthermore, the engine can be operated to switch between its

two extreme stroke positions allowing high compression ratio at its minimum stroke position, and low compression ratio at the maximum stroke position allowing a turbo-charger or supercharger to further enhance the power range of the engine.

These features and advantages of the invention will be more fully understood from the following description of a preferred embodiment taken together with the accompanying drawings.

In the drawings:

Figure 1 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the maximum displacement condition with the piston at the top-dead-centre position.

Figure 2 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the maximum displacement condition with the piston at the bottom-dead-centre position.

Figure 3 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the minimum displacement condition with the piston at the top-dead-centre position.

Figure 4 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the minimum displacement condition with the piston at the bottom-dead-centre position.

Figure 5 is a transverse cross sectional view showing the stroke adjusting rotary actuator in the maximum stroke position.

Referring to Figs. 1 and 2 of the drawings, an internal combustion engine 10 having a cylinder block 12 defining one of many cylinder bores 14. The cylinders 14 are closed at one end by a cylinder head which is provided with the usual inlet and exhaust port, valves, actuating gear and ignition means, none of which are shown.

Piston assembly 16 moves in bore 14 and connects to the rocking member 18 via connecting rod 20 and forked link 22. Connecting rod 20 is pivotally connected to the piston 16 via gudgeon pin 24, and pivotally connected to the forked link 22 via pin 26. The other end of the forked link 22 is pivotally linked to the rocking member 18 by pin 28 fixed on either side of the rocking member 18. The axes of pins 24, 26 and 28 are parallel to each other. Rocking member 18 is pivotally supported on adjusting shaft 30 in a selected geometric position longitudinal along the engine block 12 and parallel to the engine crankshaft 32 and all of the pins 24, 26 and 28. Adjusting shaft 30 rotatable on bearings (not shown) within the engine block 12 webs separating the cylinder bores 14 and crankshaft 32 conventional main bearings (not shown). Adjusting shaft 30 has eccentric pin 34 rotatably connected to connecting rod 36 linked to forked link 22 via pin 38.

The rocking member 18 connects to the crankshaft 32 via connecting rod 40, pin 42, fixed at either end to the rocking member 18, and crankpin 44. The position of pin 42 can be placed in a suitable radial position on the rocking member 18 to transmit the oscillating motion to the crankshaft 32. Thus the linear piston 16 motion is transferred to the crankshaft 32 via connecting rod 20, forked link 22, rocking member 18 oscillating shaft 30, and connecting rod 40.

The geometry of the linkage system as represented in Fig. 1 shows the engine 10 in the maximum displacement position with the piston 16 at top-dead-centre. The connection at pin 26 by connecting rod 20 and forked link 22 is held in position by connecting rod 36 pivotally connected to eccentric pin 34 on adjusting shaft 30. The position of the eccentric pin 34 is controlled by the rotational position of adjusting shaft 30 which is in turn controlled by the rotary actuator system 46, as shown in Figure 5, comprising of housing 48, and actuator vane 50 with its appropriate seals 52, able to rotate between stop limits 54 and 56. Stop 54 represents maximum stroke position and stop 52 represents minimum stroke position.

Oil channels 58 and 60 communicating with respective ports 62 and 64 on either side of actuator vane 50, allow oil under pressure from a conventional external high pressure pump and valves (not shown), to control the position of the vane 50 and thus the adjusting shaft 30, in response to the electronic engine management system determining the power demand of the vehicle from the engine 10.

Figure 2 represents the engine 10 in the bottom-dead-centre position at maximum stroke.

For the minimum stroke position, reference is made to Fig. 3 in which the vane 50 of rotary actuator 46 is made to rotate up to stop 56 and thus rotating the position of eccentric pin 34 of adjusting shaft 30 to the position shown in Figure 3. This rotational action moves forked link 22 via connecting rod 36 towards the centre of adjusting shaft 30 effectively reducing the stroke of piston 16. Figure 4 shows the engine 10 at minimum stroke and at the bottom-dead-centre position.

It is to be noted that at the minimum stroke position the top of piston 16 at top-dead-centre position moves higher up the bore 14 to compensate for the compression ratio to be approximately constant over the variable stroke adjustment. However, the respective geometries of pins 24, 26, 28, 38 and eccentric pin 34, can be selected to provide various piston adjustments and compression ratio variations, as desired by the engine designer. For example, the shape of the compression ratio variations can be designed to allow for turbo-charging or super-charging, thus producing a variable compression ratio.

It is to be understood that the variable displacement engine 10 can be operated under various conditions, for example:

In one embodiment the engine can be operated as a two position capacity engine having two displacement positions only, minimum and maximum, with either the same compression ratio or different compression ratios to allow turbo or super-charging at the maximum displacement position.

In a second embodiment the engine can be operated as a variable capacity engine throughout its variable range by controlling the position of the rotary actuator 46. A pre-determined compression ratio curve can be applied.

In a third embodiment the mechanism can be applied to horizontally opposed engine, V-engines as well as in-line engines.

The scope of the invention need not be limited to the mechanism shown, Variations in the positioning of the crankshaft and the rocking member and the method of altering the position of the linkages, either by hydraulic or mechanical systems, and in addition, the geometry of the linkages to achieve the same outcome, fall within this invention.

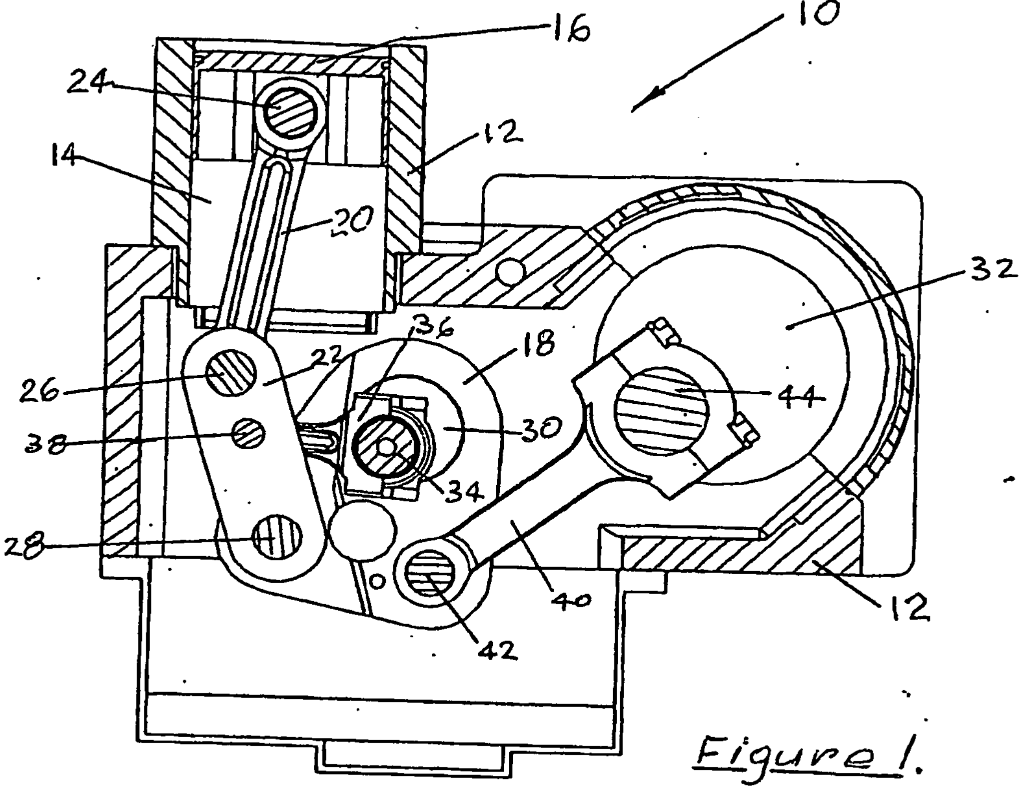

Figure 1.

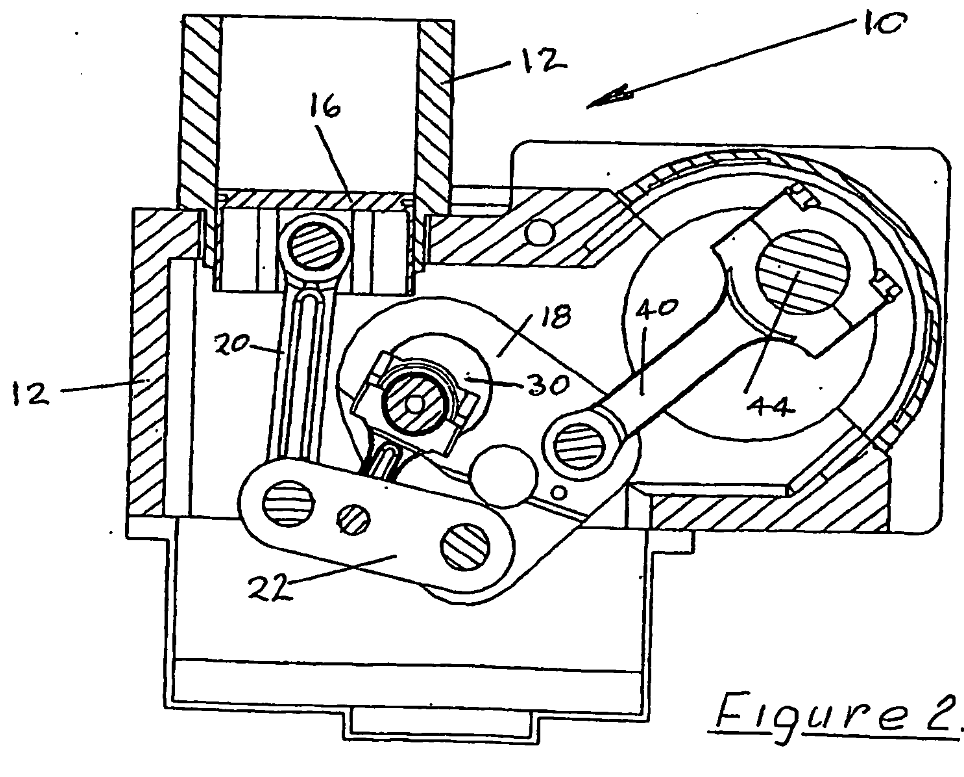

Figure 2.

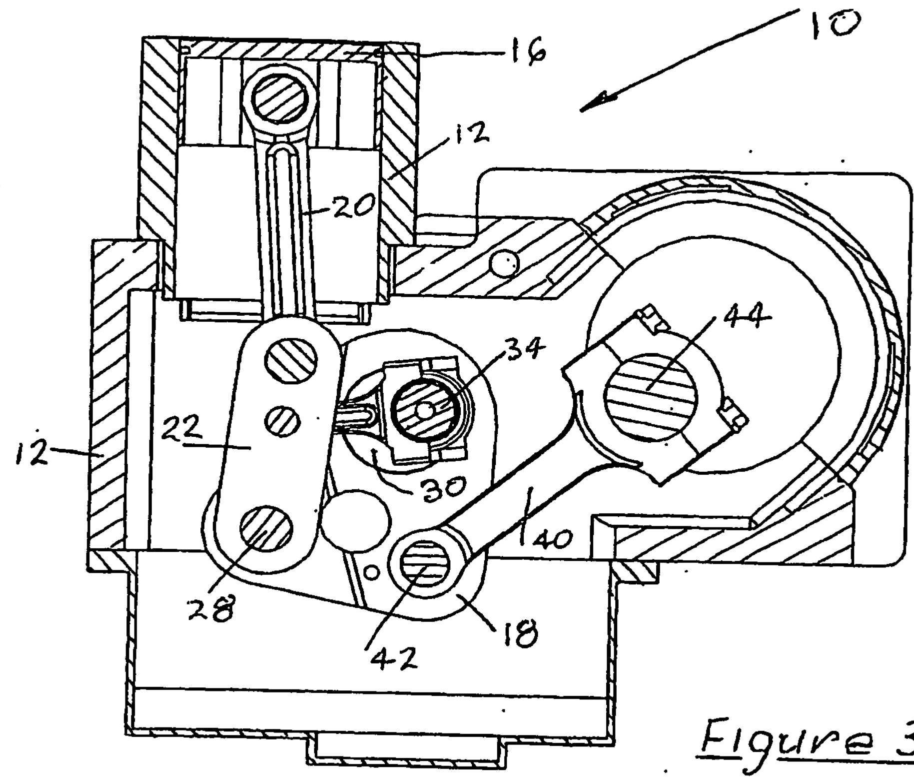

Figure 3

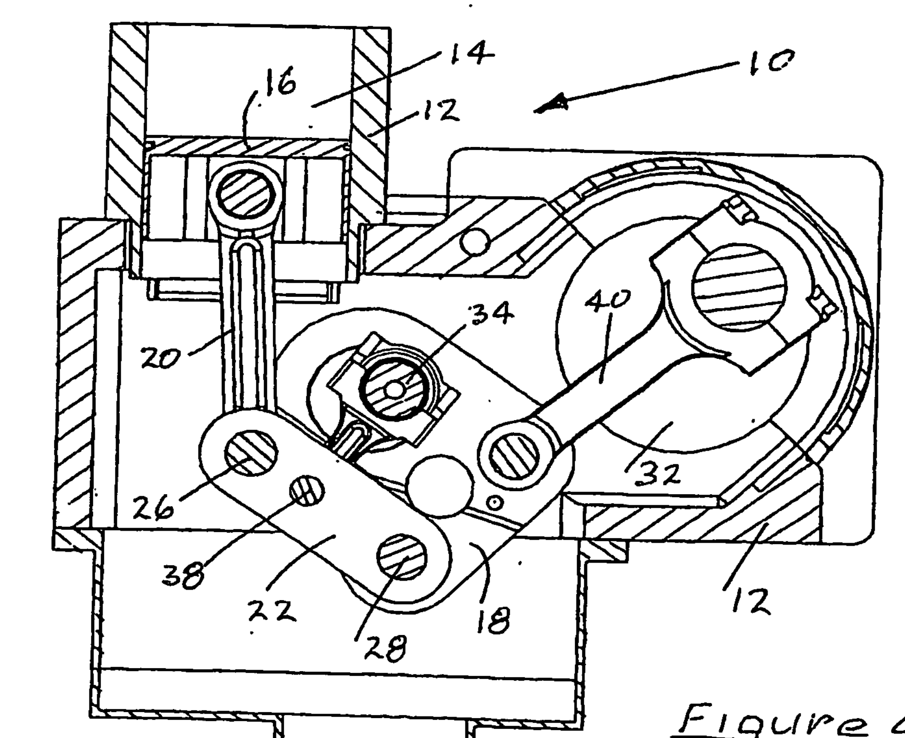

Figure 4

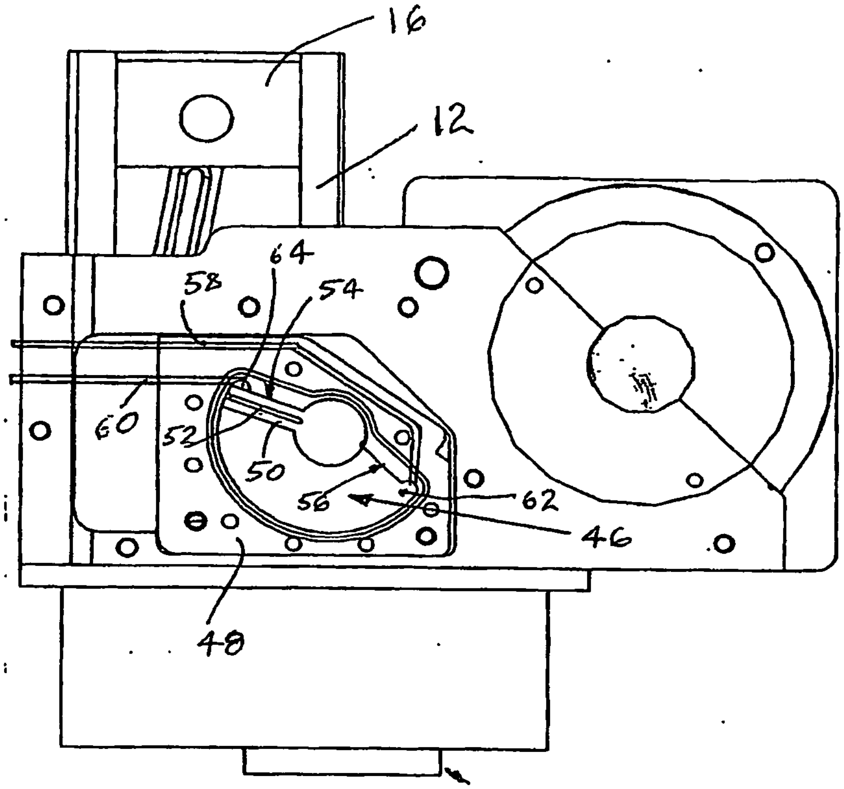

Figure 5